INSTRUCTION MANUAL

MANUAL

TIC *DUAL-RANGE AC LINE VOLTAGE REGULATO

MODEL 260A R

Serial No 1611

ELECTRONIC
MEASUREMENTS
COMPANY, INCORPORATED
EATONTOWN NEW JERSEY

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PRELIMINARY INSTRUCTION MANUAL

AUTOMATIC *DUAL-RANGE AC LINE VOLTAGE REGULATOR

MODEL 260A R

Serial No. 10014

Issued: May 1961

*Registered U.S. Patent Office. Patents issued and pending.

SECTION 1

DESCRIPTION

1-1. Model 260A Automatic Dual-Range AC Line Voltage Regulator is an electro-mechanical regulator which provides essentially constant output voltage over a wide range of input fluctuations. A sensing system provides error signals for a servo correction motor. This, in turn, drives auto transformers in the proper direction to produce a reduction of error. An unusual feature of this regulator is that it can be used to control either 115 or 230 volt ac lines at frequencies from 47 to 63 cycles per second. Change-over is effected by a very simple means available at the main terminal board of the unit.

1-2. INSPECTION. When the unit is received it should be unpacked and inspected for any sign of damage or mishandling. If, for any reason, it is desired to inspect the unit internally, this may be done by removal of the two side covers. See the Warranty at the front of this manual for instructions in the event of damage.

SECTION 2

OPERATION

2-1. INSTALLATION. This unit is supplied in two versions:

a. Wall or Floor Mounting Version (260A). This version may be placed on its rubber feet in any convenient location, or it may be hung on a wall employing the key-hole slots provided at the rear. In either case the louvers at the side should be left clear in order to permit adequate ventilation. Electrical connections for this type may be found under the small hinged cover at the lower right front of the panel. Input and output terminals are appropriately marked, and leads to them should pass through the 1¼" hole at the right side of the unit. Conductors of sufficient size should be used, bearing in mind that currents up to about 60 amperes may be handled by these lines.

b. Rack Mounting Version (260AR). This version may be set on a convenient bench or other flat surface for general purpose use, or may be mounted directly to a rack. Adequate space should surround the unit to permit ventilation. The terminal board for making connections to this unit may be found at the right, rear top corner by removing the dust cover. The input and output leads should pass through the slot provided at the rear.

2-2. VOLTAGE CHANGE-OVER. The voltage change-over devices may be found on the main terminal board in each case. These consist of two swinging links and a pair of switches with a locking link. For 230 volt operation the two swinging links of studs should be swung towards each other forming one bridge between the two inner studs. For 115 volt operation these two links should be swung outwards forming two individual links between the outer and inner studs. Next, the two toggle switches should be moved to the appropriate position, 115 or 230. This may be done by simply loosening the screw (to unlock the link) sliding the link and switch toggles to the appropriate side, and retightening the screw. The unit is then ready for the indicated voltage.

2-3. ADJUSTMENT. Adjustment may be performed after installation. Proceed as follows:

a. Connect a voltmeter to the output binding posts. The full scale sensitivity should be appropriate for the voltage being employed.

b. Turn the unit on and allow five minutes for warm-up.

c. Set the output voltage to the desired reading by employing the output voltage screw driver control.

To adjust sensitivity proceed as follows:

a. With the unit in operation slowly turn the sensitivity adjustment in a clockwise direction until the relays begin to chatter and the correction meter hunts back and forth. The monitor on the front panel will flicker continuously.

b. Back off the sensitivity adjustment until hunting stops. The closer to this point the control is set the closer will be the control of output voltage.

2-4. MONITOR. A neon monitor is provided on the front panel of this instrument. This monitor will light whenever correction is taking place. If, at any time, it should remain lighted for a period in excess of five seconds, or if it should flicker continuously, this may be taken as an indication that either a failure has occured, or readjustment is required. Internal connections are so arranged that no single failure can cause excessive voltage to be applied to the load. In any case, a failure of this type will cause this monitor to light or flicker.

2-5. SENSING ELEMENT. The sensing element for this unit is so placed as to illuminate a jewel on the front panel. As long as the unit is in operation this jewel should glow with a constant brilliance. In the event that this light fails to glow, or becomes very bright, failure of the sensing element, or some other difficulty may be taken for granted. In the event of failure of this element a new element assembly should be obtained from the factory.

SECTION 3

CIRCUIT DESCRIPTION

3-1. GENERAL. Model 260A regulates by means of a buck-boost system. When output voltage falls below the required value, a boost voltage of the right amount is inserted in series with the output voltage to return it to the correct value. Similarly, if the output voltage should rise, a bucking voltage is inserted.

3-2. BUCK-BOOST CIRCUIT. Transformer T3 provides the buck and boost power as required. The secondary windings of T3 are connected in parallel with each other for 115 volt operation or in series with each other for 230 volt operation. The power to drive transformer T3 comes from two variacs, T1 and T2. T1 provides power for one primary winding of T3, and T2 provides power for the other primary winding of T3. T1 and T2 are mechanically ganged together, and very carefully phased so that there will be a minimum of circulating current. Two variacs are provided so that the unit may be used on 115 or 230 volts. T1 and T2, the control variacs, are driven by a multi-pole, reversible, servo motor. T1 and T2 are connected in parallel across the input line for a 115 volt operation or in series for 230 volt operation.

3-3. VOLTAGE SENSING. The primary of transformer T4 is connected across the output lines of the unit. Voltage sensing is accomplished with transformer T4, a non-linear resistive element R1, and resistors R2, R3, R4 and R5. The secondary of T4, the non-linear resistive element R1, and the several resistors form an ac bridge, the sensing points of which are the tap on the secondary of T4 and the arm of the VOLT potentiometer control. The VOLT control is adjusted so that for a given voltage across the primary of T4 no voltage difference is developed between the arm of the potentiometer and the tap of the secondary of T4. If the voltage across the primary of T4, which is connected across the output of the regulator, should vary, the voltage at the secondary of T4 varies linearly. The current through the resistive leg, however, does not vary linearly. This is due to the non-linearity of the special resistive element R1. Thus a difference voltage is developed between the arm of the potentiometer and the tap of the secondary of T4. This voltage is either in phase or 180° out of phase with the primary voltage, depending upon whether the input voltage has increased or decreased.

3-4. THYRATRON DETECTOR AND RELAY DRIVER. Transformer T5, the two thyratrons V1 and V2 and associated circuitry, form the phase detector and relay driver. Any ac voltage between the arm of the potentiometer and the tap of the secondary of T4 due to a variation in the output voltage appears at the secondary of T5. The secondary of T4, in conjunction with the two 1N34A diodes, provides identical dc bias for both thyratron grids which controls the sensitivity of the amplifier. Adjustment of the SENS potentiometer thus controls the size of the ac voltage needed to fire either thyratron.

As previously noted, the ac connection of the T5 secondary to the control grids of the thyratrons causes any ac voltage to appear at the two grids 180° out of phase. The cathodes, connected together, are returned to one side of the ac input line. The plates are connected to the other side of the ac input line through two relays, K1 and K2, one thyratron operating each relay. An ac voltage is applied across both thyratrons in phase. If the excursion of the output voltage is in such a direction that the voltage applied to one control grid is in phase with the voltage applied at the plates of both thyratrons, the voltage applied to the other control grid is 180° out of phase with the voltage applied to both plates, and only the first thyratron fires. Its associated relay is therefore energized, closes, and provides power for the motor that drives the variacs. The motor will then run until the sensing bridge no longer is unbalanced and the output voltage is corrected. At that point the thyratron is extinguished and the relay opens. If the excursion of the output voltage is in the opposite direction, the other thyratron fires, closing the other relay and driving the motor in the opposite direction. Capacitors C4 and C5, and resistors R13 and R14 filter and damp the coils and prevent the relays from buzzing.

3-5. FAILURE PROTECTION. Should a failure occur or a line shift take place which is greater than can be compensated for, the motor will cycle to one end. A limit switch will be tripped, actuating relay K3 or K4 and the motor will be turned off. On standard units this trip-out position is fixed and cannot be adjusted. However, on special units, trip-out positions at 5° intervals from the original position can be supplied. Other failures (such as heater burning out in one of the thyratrons) either cause no reaction or cause the motor to cycle to one end of its travel and be automatically turned off. Failures of components in the unit, in general, will not

cause any excess damage to other parts of the unit or to equipment operated from the output of the unit.

An additional safety feature has been designed into Model 260A. Generally speaking, a relay failure is due either to open coils or sticking contacts. An open coil on the drive relays will not cause damage. However, a sticking contact could cause damage if the relays were to stick closed. Relays K1 and K2 are wired so that when K1 is closed, K2 is out of the circuit. K2 is the relay that drives the servo motor in a direction to increase the voltage. If K2 were to stick closed, the output voltage would increase until it is too high. At this time Relay K1 would be energized. This would open the circuit that causes the motor to drive in an increasing direction, and cause the motor to drive in the decreasing direction. The unit would hunt about the set voltage. This trouble would be indicated by the flickering of the nonlinear resistive element that can be seen on the front panel.

SECTION 4

MAINTENANCE

4-1. REPLACEMENT. When necessary, parts may be replaced employing the same tolerances and values indicated on the circuit schematic. If the sensing element fails, a new sensing element assembly should be obtained from the factory.

4-2. LUBRICATION. No lubrication will be required during the normal life of this instrument. Where lubrication is necessary a permanent type has been provided.

4-3. ACCESS. All the parts may be made accessible by removing the full cover at the left of the unit (looking from the front) and the partial upper cover at the right. The right hand cover will reveal all of the control wiring in a small sub-chassis. The cable to this sub-chassis is made intentionally long so that this unit may be dropped for inspection, if desired. There are two electron tubes on this chassis which may be reached without removal of the chassis by inserting the hand through the right side opening, revealed when the small upper cover is removed.

4-4. ADJUSTMENT OF VARIAC FOR MINIMUM BRUSH CURRENT. The following adjustment must be carried out whenever a variac or a gear has been replaced. Failure to make this adjustment may result in the failure of a variac.

a. Remove the dust cover to expose the underside of the thyratron amplifier and relay chassis.

b. Make input and output connections for 115 volts ac, as described in this manual.

c. Remove the CONTROL fuse to disable thyratron amplifier.

d. Remove the brush lead from one of the variacs (either will serve). Insert into the broken connection an ac ammeter of suitable range to yield a 2 ampere reading mid-scale.

e. Throw the panel circuit-breaker to ON.

f. With a screwdriver or other suitable tool, short pins 1 and 2 on one relay socket on the underside of the amplifier and relay chassis. This will rotate the variac

in one direction. Shorting pins 1 and 2 of the other relay will rotate the variac in the opposite direction.

g. Using the method of step f, rotate the variac to its limit, while reading the ammeter. Current at either limit of rotation should not exceed 1.25 amperes. Current through the middle of rotation should not exceed 0.5 amperes.

h. If current exceeds these figures, the brush carriage disc setting must be adjusted. Using a long-handled #8 hex (Allen) wrench, loosen the two set screws which fasten the brush disc to the variac shaft. Turn the disc very slightly clockwise. Then re-tighten the set screws to fasten the disc again on the shaft.

CAUTION

When tightening the set screws, press the disc toward the variac to seat the carriage disc firmly against the shaft shoulder. Maintain sufficient pressure to flatten completely the spring between disc and shoulder. If disc is not seated firmly, the brush may make intermittent contact with the variac windings.

i. Repeat step g. If meter readings still do not fall within acceptable limits, make a counter-clockwise adjustment, using the method of step h. Several adjustments may be necessary before meter readings fall within acceptable limits. However, if it is impossible to decrease the brush current to acceptable limits, or if several peaks are observed through the middle rotational sector, the variac should be replaced.

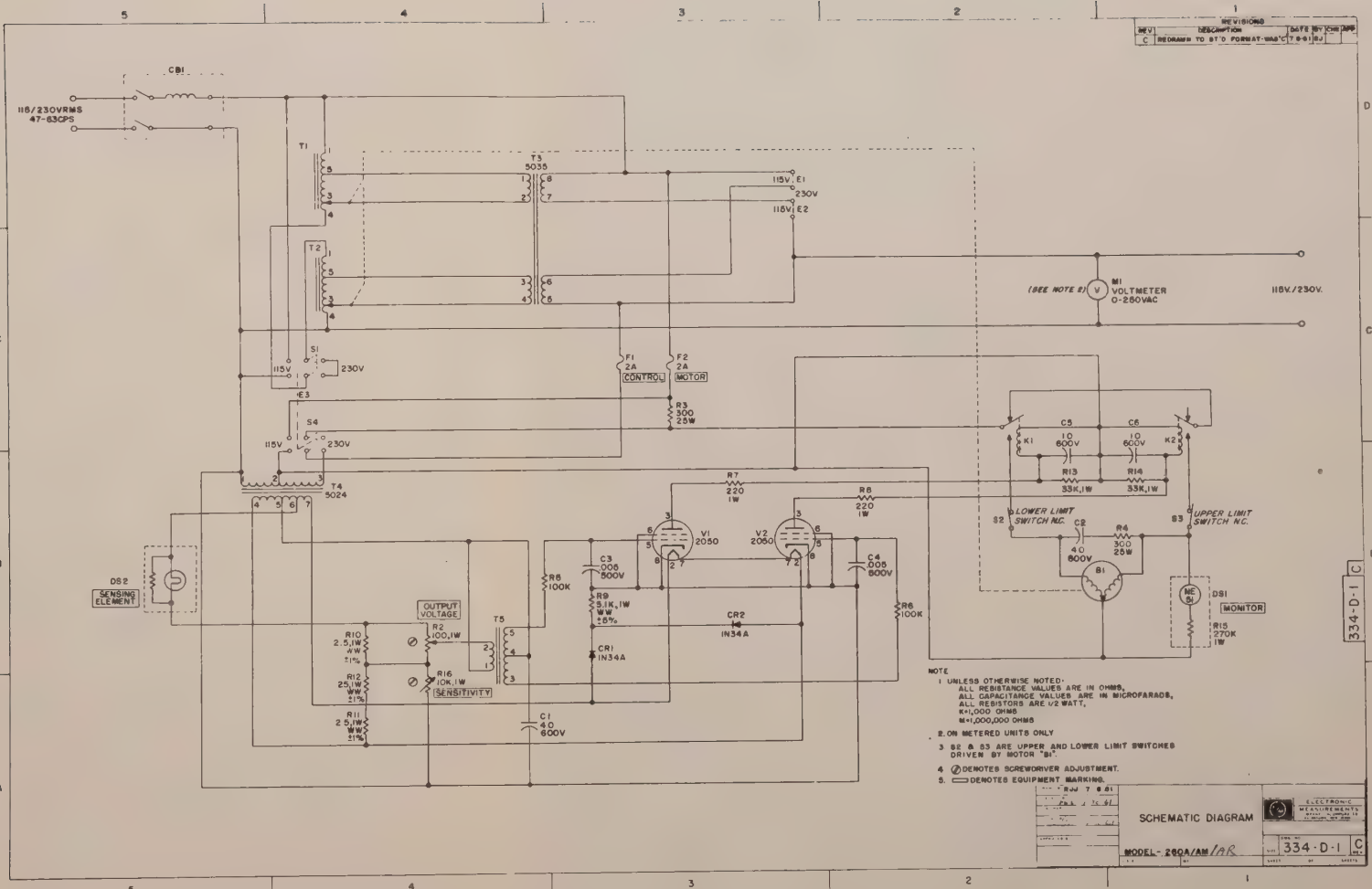
j. In performing step h, too gross an adjustment may prevent the travel stop mounted on the variac gear from engaging the microswitch, in which case the variac will bottom, bounce back, be driven again by the motor and continue to oscillate in this fashion. If this occurs, repeat step h until the stop engages the microswitch properly.

PARTS LIST 8/61

MODEL 260A/AM

REFERENCE SYMBOL	DESCRIPTION	TYPE OR PART NO.	MANUFACTURER
B1	Motor, synchronous	5SMY54HB1	G.E.
C1,2	Capacitor, oil paper, 4 UF, 600 VDC	CP41BZEF405K	Pyramid
C3,4	Capacitor, mica, 0.005 UF ±5%, 500 VDC	CM30B502J	Micamold
C5,6	Capacitor, dual bathtub, common ground, 1.0 UF,±10%, 600 VDC	DYBT 6110	Cornell-Dubilier
CB1	Circuit breaker	334-B-10 A-33	EMC
CR1,2	Diode, germanium	1N34A	Sylvania
DS1	Lamp, neon	NE-51	G.E.
DS2	Sensing element assembly	334-A-19	EMC
F1,2	Fuse, cartridge, 2A	4AG2	Sightmaster
K1,2	Relay, automatic, 5000Ω coil, 2A, cont. cap., 28 VDC, 115 VAC	Type 103	General Automatic
M1	Voltmeter, 0-250 VAC ±2% accuracy full scale, rectifier type	Model 582/V250	EMC
R1	Part of sensing element assembly, DS2	334-A-19	EMC
R2	Resistor, variable, WW, 100 ±5%, 2W, linear taper, ¼ in. dia., 1/8 in. lg. slotted shaft, series 43	CM26027	Clarostat
R3,4	Resistor, fixed, WW, vitreous enamel, 300 ±5%, 25W	25F300	Ward Leonard
R5,6	Resistor, fixed, comp, 100K ±10%, ½W	EB-1041	Allen-Bradley
R7,8	Resistor, fixed, comp, 220 ±10%, 1W	GB-2211	Allen-Bradley
R9	Resistor, fixed, WW, 5100 ±5%, 1W	BW-1	Int'l Resistance
R10,11	Resistor, fixed, WW, 2.5 ±1%, 1W	Type RL	Reon Resistor
R12	Resistor, fixed, WW, 25 ±1%, 1W	Type RL	Reon Resistor
R13,14	Resistor, fixed, comp, 33K ±10%, 1W	GB-3331	Allen-Bradley
R15	Resistor, fixed, comp, 270K (Integral part of XDS1)		
R16	Resistor, variable, WW, 10K ±5%, 2W, linear taper ¼ in. dia., 1/8 in. lg. slotted shaft, series 43	CM18924	Clarostat
S1,4	Switch, toggle, DPDT	2GL-53-73	Carling Electric
S2,3	Switch, micro	BZ2RL	Minn. Honeywell
TB1	Board, terminal	334-A-41	EMC
T1,2	Transformer, variable	334-A-23	EMC
T3	Transformer, power	5035	EMC
T4	Transformer, line	5024	EMC
T5	Transformer, input	98788	U'td. Transformer
V1,2	Tube, electron, thyratron	2050	RCA
XDS1	Holder assembly, monitor lamp, clear plastic lens	101N	Drake Mfg.
XF1,2	Extractor post, fuse	HMC	Bussman
XK1,2	Socket, 8 pin, octal	9751-9	Cinch-Jones
XV1,2	Socket, 8 pin, octal	9751-9	Cinch-Jones
E1,2	Shorting link	328-A-20	EMC
S3	Switch, locking bar	334-A-14	EMC
	Grommet, rubber, 5/8 in. id. 1-1/8 in. od., 1/16 in. groove	2285	Atl.India Rubber
	Gear, spur, modified	334-A-44	EMC
	Gear, spur, modified	334-B-43	EMC

Manufacturer's part numbers are indicative of stock employed at the time of compilation of this parts list. Unless otherwise noted, and except for Electronic Measurements (EM) part numbers, equivalent parts may be used for replacement.



NOTE
1 UNLESS OTHERWISE NOTED:
ALL RESISTANCE VALUES ARE IN OHMS,
ALL CAPACITANCE VALUES ARE IN MICROFARADS,
ALL RESISTORS ARE 1/2 WATT,
K=1,000 OHMS
M=1,000,000 OHMS
2. ON METERED UNITS ONLY
3 S2 & S3 ARE UPPER AND LOWER LIMIT SWITCHES DRIVEN BY MOTOR "B1".
4 ⊘ DENOTES SCREWDRIVER ADJUSTMENT.
5. ▭ DENOTES EQUIPMENT MARKING.

RJW 7 8 61

SCHEMATIC DIAGRAM

MODEL- 260A/AM1AR

ELECTRONIC MEASUREMENTS

SIZE 334-D-1 REV C

SHEET OF SHEETS

Warranty

Regatron instruments are guaranteed to be free from defects in material and workmanship for one year from the date of purchase (except for tubes, fuses, batteries and pilot light). Our liability under this warranty is limited to repairs and adjustments or replacements of defective parts or instruments when the fault is a direct result of defective materials or workmanship in the manufacture of the apparatus. This warranty covers service for the first year, except for transportation to and from the factory.

If any fault develops in the equipment, the following steps should be taken:

1. Notify *Electronic Measurements Co. Inc.,* giving full particulars of the difficulty and include the model and serial numbers of the instrument in question. On receipt of this information, we will give you service information or shipping instructions.
2. On receipt of shipping instructions, forward the apparatus to us, prepaid, and we will make repairs and adjustments immediately at the factory.
3. If the fault has been caused by misuse, or abnormal conditions of operation, as disclosed by our examination, repairs will be billed at cost. In this case, an estimate of the cost will be submitted before work is started.

ELECTRICAL STANDARDS

All company primary standards are either certified directly or are traceable to certification by the National Bureau of Standards.

CLAIM FOR DAMAGE IN SHIPMENT

This instrument received comprehensive visual and electrical inspections before shipment. Immediately upon receipt from the carrier, and before operation, this instrument should be inspected visually for damage caused in shipment. If such inspection reveals internal or external damage in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. When referring to this instrument, always include the model and serial numbers.